Project Manager's Quarterly Progress Report - 3rd Quarter FY 2000
U.S. Large Hadron Collider Construction Project

1. PROJECT IDENTIFIERS

Reporting Period:	Through **June 30, 2000**
Program Sponsors:	DOE High Energy Physics Division/NSF Physics Division
DOE/NSF Program Manager:	T. Toohig, (301) 903-4115, timothy.toohig@science.doe.gov
DOE/NSF Associate Program Manager:	M. Goldberg, (703) 306-1894, mgoldber@nsf.gov
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DOE/NSF Project Manager:	J. Yeck, (630) 840-2530, jim.yeck@ch.doe.gov

2. PROJECT DESCRIPTION

The Department of Energy (DOE) and the National Science Foundation (NSF) have signed agreements committing to collaboration in the construction of the Large Hadron Collider (LHC) at CERN (European Laboratory for Particle Physics) and two of its associated detectors. The U.S. fabrication effort will be carried out at, or under the supervision of, U.S. universities and national laboratories under the terms and conditions described in the International Collaboration Agreement (Agreement) and its Accelerator and Experiments Protocols. The U.S. LHC Construction Project is defined by the goods and services to be provided to CERN under the terms of the Agreement between DOE, NSF, and CERN. These goods and services include DOE contributions to the LHC accelerator, and DOE and NSF contributions to the ATLAS (A Toroidal LHC Apparatus) and CMS (Compact Muon Solenoid) experiments.

The DOE contribution to the LHC accelerator consists of items provided by DOE National Laboratories and CERN direct purchases from U.S. industrial firms. The scope of these contributions is addressed in the Accelerator Protocol and described in detail in an Implementing Arrangement between the collaborating DOE National Laboratories and CERN. The DOE and NSF contributions to the ATLAS and CMS detectors consist of items supplied by the collaborating U.S. universities and DOE National Laboratories. The scope of these contributions is addressed in the Experiments Protocol and described in detail in Memoranda of Understanding for collaboration on construction of each experiment.

The U.S. LHC Construction Project includes the U.S. ATLAS, U.S. CMS, and U.S. LHC Accelerator projects. This report summarizes the overall status of the U.S. LHC Construction Project effort and includes more detailed status information on each sub-project. Additional information can be accessed at the following web sites:

U.S. LHC Project - http://www.hep.net/doe-hep/lhc.html

LHC Project - http://wwwlhc.cern.ch/	U.S. LHC Accelerator - http://www-td.fnal.gov/
ATLAS - http://atlasinfo.cern.ch/Atlas/Welcome.html	U.S. ATLAS - http://www.usatlas.bnl.gov/
CMS - http://cmsinfo.cern.ch/Welcome.html	U.S. CMS - http://uscms.fnal.gov/

3. PROJECT MANAGER'S NARRATIVE HIGHLIGHTS

The current list of DOE/NSF project reviews and status meetings is provided below:

U.S. LHC Construction Project	Event	Date
U.S. CMS Detector	DOE/NSF Review	April 11-13, 2000
U.S. LHC Accelerator	DOE/NSF Review	May 16-17, 2000
U.S. ATLAS Detector	Quarterly Status Meeting	June 9, 2000
U.S. CMS Detector	Quarterly Status Meeting	July 14, 2000
U.S. LHC Accelerator	Quarterly Status Meeting	August 22, 2000
U.S. ATLAS Detector	DOE/NSF Review	September 13, 2000
U.S. CMS Detector	DOE/NSF Review	October 11, 2000
U.S. LHC Accelerator	DOE/NSF Review	November 28-30, 2000
U.S. ATLAS Detector	Quarterly Status Meeting	December 12, 2000

The results of these activities are documented in formal reports and meeting notes. The U.S. CMS and ATLAS projects submit monthly reports and the U.S. LHC Accelerator project submits a quarterly report. Current performance data is summarized in the following tables:

Table 3.1, Schedule Performance Indices

	Planned Complete (BCWS/BAC)	Actual Complete (BCWP/BAC)	Schedule Performance (BCWP/BCWS)
U.S. ATLAS	25%	24%	96%
U.S. CMS	53%	46%	86%
U.S. LHC Accelerator	51%	47%	92%

Table 3.2, Contingency Status (in thousands of dollars)

	Total Project Cost (TPC)	Budget at Completion (BAC)	Contingency	Budgeted Cost of Work Performed (BCWP)	Remaining Work to be Performed (BAC-BCWP)	Contingency/ (BAC-BCWP)
US ATLAS	163,750	128,676	35,074	30,997	97,679	36%
US CMS	167,250	129,205	38,045	59,954	69,251	55%
US Accelerator	110,000	94,724	15,276	44,096	50,628	30%

Table 3.3, Cost & Schedule Performance (in thousands of dollars)

	Cumulative Costs to Date					Costs at Completion		
	Budgeted Cost			Variance			Revised	
	Work Scheduled	Work Performed	Actual Cost	Schedule	Cost	Budgeted	Estimate	Variance
U.S. ATLAS	32,357	30,997	32,121	-1,360	-1,124	163,750	163,750	0
U.S. CMS	68,197	59,954	63,302	-8,243	-3,348	167,250	167,250	0
U.S. LHC Accelerator	48,031	44,096	46,795	-3,935	-2,699	110,000	110,000	0
CERN Invoices	14,615	14,615	14,615	0	0	90,000	90,000	0
U.S. LHC Total	162,202	139,386	142,032	-22,816	-2,646	531,000	531,000	0

4. PROJECT MANAGER'S ASSESSMENT

The U.S. projects continue to meet their goals and are reliable and influential partners in the construction of the ATLAS and CMS detectors and the LHC machine.

Cost - Cost performance is good as material contracts are typically below estimates and labor costs continue to track close to plans. Project reviews and reports confirm that each project has adequate contingency available. The detector projects are in the production phase and cost experience on production labor will be an important future indicator of cost performance.

Schedule - Schedule performance is measured through milestone completion and by earned value. These measurements indicate that schedule progress is behind plans averaging about ninety percent of the baseline plan. CERN expects to complete construction of the LHC in 2005 and initiate collider commissioning. The U.S. schedules are consistent with this goal.

Technical - We remain confident that the U.S. deliverables to CERN can be realized with the planned funding. The U.S. LHC Construction Project deliverables are accepted by CERN and approved by the DOE/NSF Joint Oversight Group. We hope to provide additional items to CERN, within the approved funding, should cost performance be favorable.

ISSUES

LHC Schedules - CERN is completing a review of the schedules for the LHC machine and the ATLAS and CMS experiments. The results of this review will be presented at the CERN Council meeting in December 2000. We expect CERN to reaffirm the July 2005 completion date and to present a new commissioning scenario. The goals of this scenario are beam in one ring in July 2005, two weeks of collisions in October 2005, and start of the physics run in April 2006. DOE and NSF staff are monitoring this planning activity.

ATLAS and CMS Technical Integration – Staff levels for ATLAS and CMS technical integration and coordination has been less than necessary. Recently CERN provided additional positions to ATLAS and CMS and are evaluating the situation as part of the schedule review.

Radiation Hard Electronics - Although there has been technical progress in the development of radiation hard electronics for the ATLAS and CMS experiments, significant challenges remain including production yields and the viability/interest of current vendors. Export license and dual-use technology issues are additional complications.

Russian Collaborators - Some collaborators on the experiments are behind on their commitments. The Russian collaborators are well behind their original plan but are beginning to show some improvement. ATLAS and CMS management continue to address shortfalls from Russian and other collaborators when schedules dictate. U.S. CMS has accepted additional responsibilities for the hadron calorimeter tasks in order to hold schedule.

5. NARRATIVE SUMMARY

5.1 U.S. ATLAS CONSTRUCTION PROJECT

ATLAS International – The ATLAS Spokesperson, Peter Jenni, addressed the status of the overall ATLAS experiment at the April 2000 Resource Review Board meeting. Highlights from the Spokesperson are summarized below.

- The fabrication of the large, time-critical components of the common projects are well underway including the magnets and the liquid argon cryostats.
- Emphasis is being given to integration issues that are on the critical path.
- Critical items to be resolved include the barrel toroid coil casing, the liquid argon electrodes, the liquid argon endcap construction and cold tests, and radiation-hard electronics. The collaboration is making dedicated efforts to address these problems and to recover schedule.
- The overall ATLAS and detector subsystem schedules are under revision with the goal of a working detector in October 2005 and the full detector in April 2006.

U.S. ATLAS - A DOE/NSF Quarterly Status Meeting was conducted on June 9, 2000, at Indiana University. The meeting participants concluded that there is good technical progress on all fronts but the supply of parts for U.S. production sites is a significant concern. A major revision to the Level 2 cost and schedule baseline was approved immediately following the meeting. The revised schedule milestones are consistent with the ATLAS need dates. U.S. ATLAS highlights are summarized below.

- Fabrication of the barrel cryostat for the liquid argon calorimeter is progressing quite well at Kawasaki Heavy Industries. Photos are at http://www.usatlas.bnl.gov/barrel.htm .
- Production is underway for the liquid argon signal feed-throughs.
- The warm vessel for the liquid argon cryostat was successfully vacuum tested.
- Tile calorimeter modules are now being delivered to CERN and progress on mechanical assemblies is slightly ahead of schedule.
- There are mixed results on the development of radiation hard electronics. This issue will continue to require a substantial, coordinated effort by the U.S. groups and their international collaborators.
- There are delays in bringing the Transition Radiation Tracker detectors into production. The visit at IU demonstrated that the facilities are ready to proceed but the supply of components is a concern.
- The U.S. Muon Monitored Drift Tube assembly sites at Boston, Michigan and Seattle were qualified as production ready by ATLAS. All three module 0 (first module using production tooling) were completed. Production is ready to proceed but the supply of parts is a continuing concern.
- The U.S. project team continues to work with the ATLAS subsystem project leaders on schedule issues in an effort to keep U.S. deliverables consistent with ATLAS need dates.

5.2 U.S. CMS CONSTRUCTION PROJECT

CMS International - The CMS Spokesperson, Michel Della Negra, presented the status of the CMS experiment at the Resource Review Board meeting in April 2000. Highlights presented by the Spokesperson are summarized below.

- There is good progress on the solenoid magnet with some delay in coil winding.
- The experiment has taken beneficial occupancy of the assembly building.
- There are delays in the excavation of the access shafts.
- The collaboration has approved a new strategy for the central tracker that avoids staging. This strategy eliminates the micro-strip gas chambers and relies entirely on silicon layers.
- CMS leadership has evaluated the risk of funding shortfalls from collaborating countries including Russia and has developed contingency plans for addressing the shortfall.
- CMS is making plans for a "working" detector ready for first beam in 2005, taking into account technical and financial constraints. This plan supports completion of major fractions of each detector subsystem in time for first beam.

U.S. CMS - A DOE/NSF Quarterly Status Meeting was conducted July 14, 2000, at Fermilab. The meeting participants were impressed by the technical progress and generally satisfied with cost performance. There are some schedule concerns, in particular a delay in the design of the front-end electronics for the hadron calorimeter and the start of production for the Cathode Strip Chamber (CSC) assemblies. The meeting agenda emphasized production readiness for the CSC assemblies. U.S. CMS status highlights are summarized below.

- The barrel brass absorber and scintillator tiles for the Hadron Calorimeter are on schedule. The front-end electronics are behind schedule and the project has developed a corrective action plan.
- Cathode Strip Chambers assemblies for the Endcap Muon system are now in production. Panel production continues at the rates needed to support assembly prouduction.
- There are now a number of critical path schedule concerns for the Electromagnetic Calorimeter including the supply of lead-tungstate crystals, the mechanical assembly design and fabrication, and electronics. While the U.S. is not responsible for the crystals and the mechanical assembly we do have responsibilities for electronics. The problems with radiation hardness are being addressed through work on an alternative design.
- The Trigger/Data Acquisition System Application Specific Integrated Circuit (ASIC) submissions for the calorimeter are in progress. The muon trigger has been redesigned.
- A readout chip setup for the Forward Pixels has successfully completed a test beam run at Fermilab.
- All U.S. responsibilities for CMS Common Projects are under contract. Fermilab awarded the final contracts for aluminum stabilizer and bulk aluminum. The first 1400-ton barrel yoke ring is complete.

5.3 U.S LHC ACCELERATOR CONSTRUCTION PROJECT

LHC - CERN is maintaining the July 2005 turn on date for the machine. Interim milestones are routinely met but there is essentially no schedule float. The commissioning scenario is being revised with a goal of beam in one ring in July 2005, collisions for two weeks in October 2005, and the start of the physics run in April 2006.

U.S. LHC Accelerator - A DOE review was conducted on May 3-4, at Brookhaven National Laboratory. U.S. LHC Accelerator highlights are summarized below.

Interaction Region (IR) Quadrupoles

- The prototype magnet production is underway. The short model magnet R&D program was completed with the final 1.8 meter model magnet confirming the magnet design meets all LHC requirements.
- A cost review of the IR quad program was completed. Costs are tracking close to plan.
- The heat exchanger test units delivered to CERN are now under test.

Interaction Region and RF Region Dipoles

- The second of two 3-meter prototype magnets was produced and successfully tested.
- The production schedule will be delayed four to six months to better match CERN's schedules for supplying parts and approved interface specifications.

IR Feedboxes and Absorbers

- Detailed design work on the Feedboxes and Absorbers is well underway.
- Functional specification for IR absorbers was approved by CERN.
- The contract for high temperature superconductor leads was awarded.

Superconducting Cable Testing and Production Support

- Upgrades to the superconductor test facility at BNL are completed and a few pre-production samples were delivered by CERN. The supply of production samples is well behind schedule.

Accelerator Physics

- BNL/LBNL/Fermilab continue to hold workshop on LHC accelerator physics topics.

CERN Direct Purchases - DOE reimburses CERN for their payments to qualified U.S. vendors [Reference U.S.-CERN Agreement and Accelerator Protocol]. The status is shown in Table 5.1.

Table 5.1, Status of DOE Payments (in $000)

Contract Item	Company (U.S. supplier)	Amount Paid	Contract Price	w/ options & escalation
Niobium-Titanium Alloy Bars	Wah Chang	12,656	38,667	48,431
Niobium Sheets	Wah Chang	1,667	5,633	6,951
Superconducting Cable	IGC Advanced Superconductors	1,151	16,447	20,985
Polyamide Insulation Film	Kaneka High Tech Materials	0	5,425	6,510
Enameled Superconductor	IGC Advanced Superconductors	0	746	968
Totals		15,474	66,918	83,875

6. FINANCIAL/COST STATUS AND PLANS

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TOTAL PROJECT FUNDING PLAN (then year millions of dollars)*

Fiscal Year	FY96	FY97	FY98	FY99	FY00	FY01	FY02	FY03	FY04	FY05	Total
Machine Funding Profiles (DOE)											
US LHC	2.00	6.67	14.00	15.40	24.92	9.38	14.20	11.20	8.33	3.90	110.00
CERN Direct	0.00	0.00	0.00	8.09	8.29	17.92	15.00	14.90	15.00	10.80	90.00
Machine Total	2.00	6.67	14.00	23.49	33.21	27.30	29.20	26.10	23.33	14.70	200.00
Detector Funding Profiles (DOE and NSF)											
US ATLAS	1.70	3.71	10.05	25.63	28.43	26.80	25.85	21.89	14.69	5.00	163.75
DOE	1.70	3.71	10.05	9.00	16.49	14.51	13.20	14.60	14.69	5.00	102.95
NSF	0.00	0.00	0.00	16.63	11.94	12.29	12.65	7.29	0.00	0.00	60.80
US CMS	2.30	4.62	10.95	38.03	24.26	21.27	21.81	21.73	15.98	6.30	167.25
DOE	2.30	4.62	10.95	32.51	20.30	17.19	17.60	19.30	15.98	6.30	147.05
NSF	0.00	0.00	0.00	5.52	3.96	4.08	4.21	2.43	0.00	0.00	20.20
Detectors Total	4.00	8.33	21.00	63.66	52.69	50.07	55.66	45.72	29.87	0.00	331.00

TOTAL DOE & NSF FUNDS, COSTS, & COMMITMENTS (cumulative $000)†

U.S. LHC Construction Project	A = Funds Allocated	B = Estimate Actual Costs	C = Open Commitments	D= B+C Total	A–D = Funds Available
U.S. ATLAS	69,520	32,121	5,722	37,843	31,677
U.S. CMS	80,160	63,302	2,058	65,360	14,800
U.S. LHC Accelerator	58,170	43,927	2,868	46,795	11,375
CERN Direct Purchases	16,380	14,615	0	14,615	6,585
Total	229,050	153,965	10,648	164,613	64,437

* This report includes a revision to the funding profile for the U.S. LHC Construction Project that is addressed in the FY 2001 budget planning for DOE. The revision to the original profile was made in order to better match the needs of the construction projects. This report also includes a change in the distribution of funds between the U.S. LHC Accelerator project and the CERN direct project to address delays in CERN invoices.

† Based on financial reports from the U.S. LHC construction projects. NSF funding is provided after the beginning of the fiscal year and therefore it is necessary to carry-over funding into the subsequent fiscal years.

7. DOE/NSF COST BASELINES AT LEVEL 2 (in $000)

U.S. ATLAS Cost Baseline

WBS	Description	Previous	Change	Current
1.1	Silicon System	18,029	540	18,569
1.2	Transition Radiation Tracker	8,187	892	9,079
1.3	Liquid Argon Calorimeter	39,871	1,101	40,972
1.4	Tile Calorimeter	6,950	962	7,912
1.5	Muon Spectrometer	19,835	4,108	23,943
1.6	Trigger/Data Acquisition System	11,000	-43	10,957
1.7	Common Projects	9,179		9,179
1.8	Education	286		286
1.9	Project Management	7,779		7,779
	Contingency	42,634		35,074
	U.S. ATLAS Total Project Cost Baseline	163,750	0	163,750

U.S. CMS Cost Baseline

WBS	Description	Previous	Change	Current
1.1	Endcap Muon	33,846	453	34,299
1.2	Hadron Calorimeter	37,167	141	37,308
1.3	Trigger and Data Acquisition	12,975	12	12,987
1.4	Electromagnetic Calorimeter	9,455	3	9,458
1.5	Forward Pixels	6,018	10	6,028
1.6	Common Projects	23,000		23,000
1.7	Project Office	6,125		6,125
1.8	Silicon	0		0
	Contingency	38,664		38,045
	U.S. CMS Total Project Cost Baseline	167,250	0	167,250

U.S. LHC Accelerator Cost Baseline

WBS	Description	Previous	Change	Current
1.1	Interaction Region Components	49,527		49,527
1.2	Radio Frequency Straight Section	14,646		14,646
1.3	Superconducting Wire and Cable	11,868		11,868
1.4	Accelerator Physics	5,133		5,133
1.5	Project Management	13,550		13,550
	Contingency	15,276		15,276
	U.S. LHC Accelerator Total Project Cost Baseline	110,000	0	110,000

8. SCHEDULE STATUS AND PLANS

8.1 U.S. ATLAS Construction Project Milestones

U.S. ATLAS Major Project Milestones (Level 1)

Description	Baseline Schedule	Forecast (F) Date	Actual (A) Date
Project Start	01-Oct-95	01-Oct-95 (F)	01-Oct-95 (A)
Project Completion	30-Sep-05	30-Sep-05 (F)	

U.S. ATLAS Major Project Milestones (Level 2)

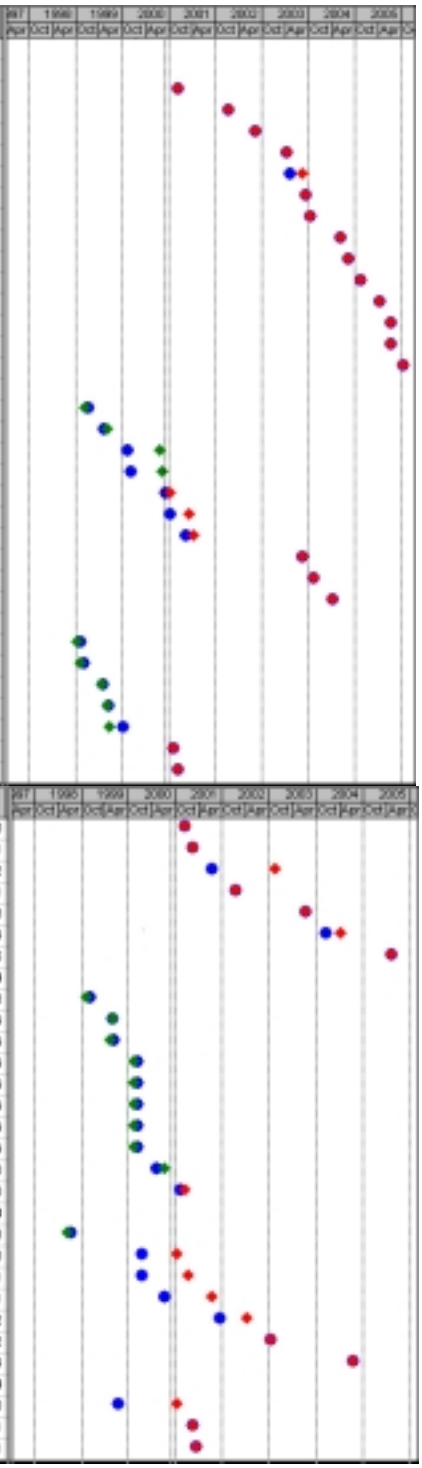
Subsystem	**Schedule Designator**	**Description**	**Baseline Schedule**	**Forecast (F) / Actual (A) Date**
Silicon (1.1)	SIL L2/1	Start Full Silicon Strip Electronics Production	23-Apr-01	23-Apr-01 (F)
	SIL L2/2	Start Full Strip Module Production	26-Nov-01	26-Nov-01 (F)
	SIL L2/3	ROD Design Complete	14-Jun-01	14-Jun-01 (F)
	SIL L2/4	Complete Shipment of Silicon Strip Module Production	13-Oct-03	13-Oct-03 (F)
	SIL L2/5	ROD Production/Testing Complete	13-Mar-03	13-Mar-03 (F)
TRT (1.2) Mechanical	TRT L2/1	Final Design Complete	31-Dec-98	07-Dec-98 (A)
	TRT L2/2	Module Production Complete	03-Feb-03	03-Feb-03 (F)
	TRT L2/3	Barrel Construction Complete	16-Sep-03	16-Sep-03 (F)
Electrical	TRT L2/4	Select Final Elec Design	15-Jun-01	15-Jun-01 (F)
	TRT L2/5	Start Production of ASICS	06-Dec-01	06-Dec-01 (F)
	TRT L2/6	Installation Complete	04-Jan-05	04-Jan-05 (F)
LAr Cal (1.3)	LAr L2/1	Cryostat Contract Award	24-Jul-98	05-Aug-98 (A)
	LAr L2/2	Barrel Feedthroughs Final Design Review	30-Sep-98	02-Oct-98 (A)
	LAr L2/3	Start Electronics Production (Preamps)	30-Jun-00	30-Jun-00 (A)
	LAr L2/4	FCAL Mechanical Design Complete	14-Dec-98	15-Dec-99 (A)
	LAr L2/5	FEB SCA Prod. Chip Submission/Contract Award	02-Mar-01	02-Mar-01 (F)
	LAr L2/6	Level 1 Trigger Final Design Complete	02-Jan-01	02-Jan-01 (F)
	LAr L2/7	ROD Final Design Complete	01-Jun-02	01-Jun-02 (F)
	LAr L2/8	Motherboard System Production Complete	01-Jun-02	01-Jun-02 (F)
	LAr L2/9	Cryostat Arrives at CERN	15-May-01	15-May-01 (F)
	LAr L2/10	Barrel Feedthroughs Production Complete	15-Oct-01	15-Oct-01 (F)
	LAr L2/11	FCAL-C Delivered to EC	17-Oct-02	17-Oct-02 (F)
	LAr L2/12	FCAL-A Delivered to EC	08-Dec-03	08-Dec-03 (F)

U.S. ATLAS Major Project Milestones (Level 2) (Continued)

Subsystem	Schedule Designator	Description	Baseline Schedule	Forecast (F) / Actual (A) Date
Tile Cal (1.4)	Tile L2/1	Start Submodule Procurement	01-Sep-97	01-Sep-97 (A)
	Tile L2/2	Technology Choice for F/E Electronics	15-Nov-97	15-Nov-97 (A)
	Tile L2/3	Start Module Construction	01-May-99	20-Sep-99 (A)
	Tile L2/4	Start Production of Motherboards	01-Oct-00	01-Oct-00 (F)
	Tile L2/5	All Electronic Components Delivered to CERN	01-Oct-02	01-Oct-02 (F)
	Tile L2/6	Module Construction Complete	30-Sept-02	30-Sep-02 (F)
	Tile L2/7	All Modules Delivered to CERN	20-Dec-02	20-Dec-02 (F)
Muon (1.5)	Muon L2/1	Start MDT Chambers Lines 1 and 3	17-Jul-00	**15-Aug-00 (F)**
	Muon L2/2	Start CSC Chamber Production	01-Mar-01	01-Mar-01 (F)
	Muon L2/3	MDT Electronics ASD PRR	19-Oct-01	01-Oct-01 (F)
	Muon L2/4	Final Design of Global Alignment Devices Complete	01-Apr-02	01-Apr-02 (F)
	Muon L2/5	CSC IC Production Complete	18-Dec-02	18-Dec-02 (F)
	Muon L2/6	Kinematic Mount Design Complete	30-Jan-01	30-Jan-01 (F)
	Muon L2/7	MDT Chambers (U.S.) Production Complete	14-Sep-04	14-Sep-04 (F)
	Muon L2/8	Kinematic Mount Production Complete	22-May-04	22-May-04 (F)
	Muon L2/9	CSC ROD Production Complete	05-Nov-03	04-Nov-03 (F)
	Muon L2/10	MDT Elec.'s Mezzanine Production Complete	06-Dec-02	06-Dec-02 (F)
	Muon L2/11	CSC Assembly/Testing at CERN Complete	17-Dec-04	17-Dec-04 (F)
	Muon L2/12	Global Alignment System Final Delivery	30-Sep-04	30-Sep-04 (F)
Trigger/ DAQ (1.6)	TDAQ L2/1	Select Final LVL2 Architecture	31-Dec-99	31-Mar-00 (A)
	TDAQ L2/2	LVL2 Trigger Design Complete	31-Dec-01	31-Dec-01 (F)
	TDAQ L2/3	LVL2 Trigger Prototype Complete	30-Sep-01	30-Sep-01 (F)
	TDAQ L2/4	Start Production	08-Jan-02	08-Jan-02 (F)
	TDAQ L2/5	Start Installation & Commissioning	05-Mar-02	05-Mar-02 (F)
	TDAQ L2/6	Production Complete	29-Oct-04	29-Oct-04 (F)
	TDAQ L2/7	LVL2 Installation & Commissioning Complete	31-Dec-04	31-Dec-04 (F)

8.2 U.S. CMS Construction Project Milestones

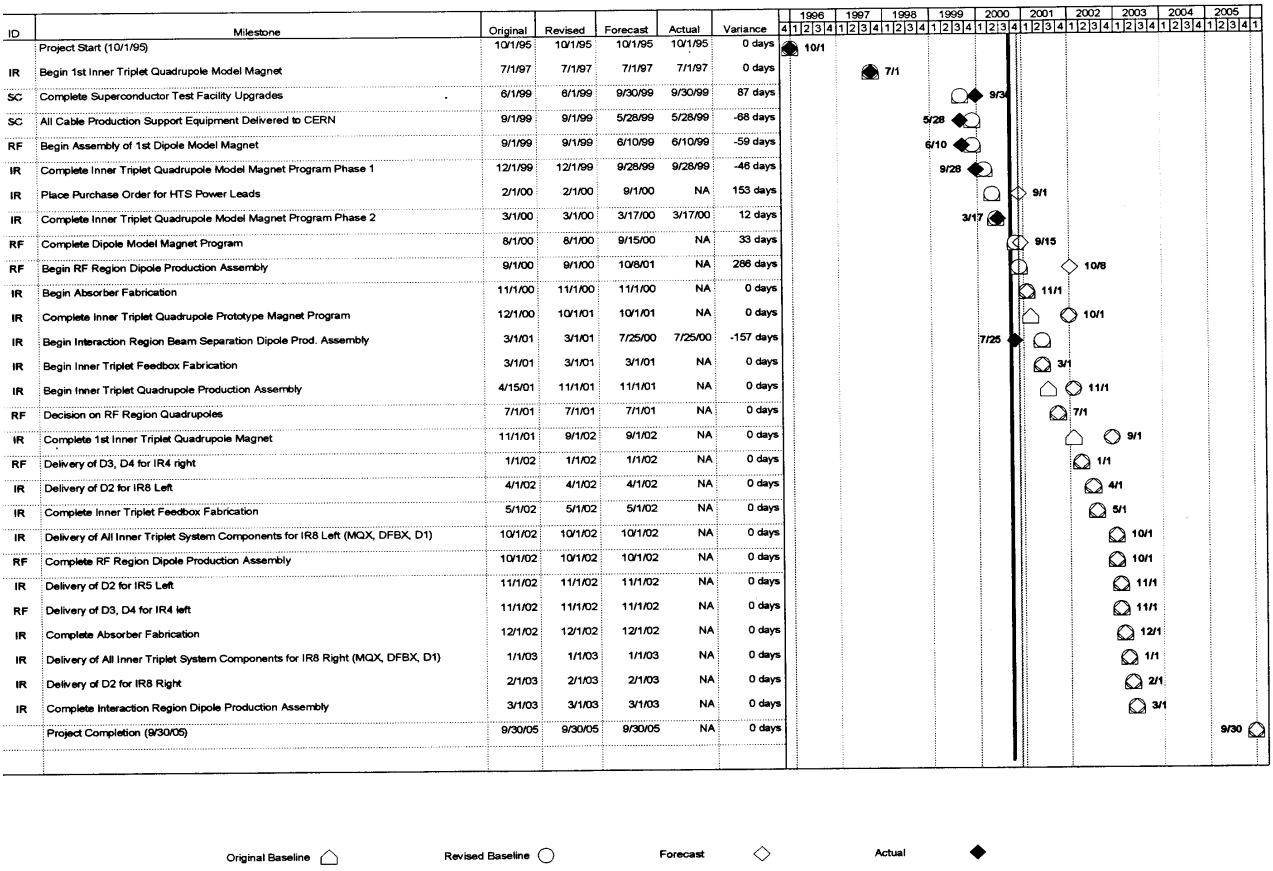
System	Level?	CMS ID	Milestone	Variance	Baseline Start	Start
			CMS L1 Milestones	**0 days**	**NA**	**Oct 31 '95**
CMS1	ML1		Project Start (10/31/95)	0 days	Oct 31 '95	Oct 31 '95
CMS1	ML1	D-804	Submit Trigger Technical Design Report (TDR)	0 days	Nov 30 '00	Nov 30 '00
CMS1	ML1	D-814	Submit DAQ Technical Design Report (TDR)	0 days	Dec 31 '01	Dec 31 '01
CMS1	ML1	HB-017	End Assembly of HB (Barrel) in Surface Hall (SX5)	0 days	Jul 31 '02	Jul 31 '02
CMS1	ML1	HE-012	End Assembly of HE (Endcap) in SX5	0 days	Mar 31 '03	Mar 31 '03
CMS1	ML1	HB-018	End Trial Insertion of HB in Vacuum Tank	65 days	May 01 '03	Jul 31 '03
CMS1	ML1	E-815	Trial Mounting of EB Supermodule on HB Complete	0 days	Aug 31 '03	Aug 31 '03
CMS1	ML1	S-822	Close Yoke and Start Magnet Test in SX5	0 days	Sep 30 '03	Sep 30 '03
CMS1	ML1	HB-023	End Installation and Test of HB in UX5	0 days	May 31 '04	May 31 '04
CMS1	ML1	HE-015	End Installation and Test of HE in UX5	0 days	Jul 31 '04	Jul 31 '04
CMS1	ML1	E-819	End Inst., Testing, & Debug. of EB (barrel) in UX5	0 days	Oct 31 '04	Oct 31 '04
CMS1	ML1	M-019	End Install. of ME (Endcap) Stations in YE in UX5	0 days	Mar 31 '05	Mar 31 '05
CMS1	ML1	T-814	End Installation and Test of Tracker in UX5	0 days	Jun 30 '05	Jun 30 '05
CMS1	ML1	HF-025	End Installation and Test of HF in UX5	0 days	Jun 30 '05	Jun 30 '05
CMS1	ML1		Project Completion (9/30/05)	0 days	Sep 30 '05	Sep 30 '05
			Muon System (WBS 1.1)	**0 days**	**NA**	**Dec 02 '98**
MUON	ML2	M-089	Mechanical Engineering Design Review	-14 days	Dec 31 '98	Dec 02 '98
MUON	ML2	M-010	Begin Mass Production of CSC Parts (panels)	21 days	Apr 30 '99	May 31 '99
MUON	ML2	M-011	Begin Assembly of Cathode Strip Chambers at FNAL	173 days	Oct 31 '99	Jul 14 '00
MUON	ML2	M-012	Pre-Production ASIC's Ready	164 days	Nov 30 '99	Aug 01 '00
MUON	ML2	M-013	Begin Mass Production of Electronics Boards	22 days	Aug 31 '00	Sep 30 '00
MUON	ML2	M-014	Begin Mounting Electronics and Testing at UCLA/UF	97 days	Sep 30 '00	Feb 28 '01
MUON	ML2	M-015	Begin CSC Assembly-PNPNSt. Petersburg & IHEP,Beijing	43 days	Jan 31 '01	Mar 31 '01
MUON	ML2	M-016	58% of the Chambers Installed	0 days	Jul 31 '03	Jul 31 '03
MUON	ML2	M-017	All Large Chambers Assembled and Tested	0 days	Oct 31 '03	Oct 31 '03
MUON	ML2	M-018	All Chambers Installed	0 days	Mar 31 '04	Mar 31 '04
			HCAL System (WBS 1.2)	**0 days**	**NA**	**Oct 02 '98**
HCAL	ML2	HB-050	HB: PP1 Absorber Delivered to CERN	-21 days	Oct 31 '98	Oct 02 '98
HCAL	ML2	HB-001	HB: Mechanical Engineering Design Review	-19 days	Nov 30 '98	Nov 03 '98
HCAL	ML2	HB-052	HB: PP#2 Absorber Delivered to CERN	-8 days	Apr 28 '99	Apr 15 '99
HCAL	ML2	HO-001	HO Engineering Design Review	-4 days	Jan 08 '99	Jan 02 '99
HCAL	ML2	HE-001	HE Mechanical Engineering Design Review	-78 days	Sep 30 '99	Jun 12 '99
HCAL	ML2	HF-006	HF Engineering Design Review Complete	0 days	Oct 31 '00	Oct 31 '00
HCAL	ML2	HB-010	HB-1 Absorber Delivered to CERN	0 days	Nov 30 '00	Nov 30 '00
HCAL	ML2	HB-010	HB-1 Absorber Delivered to CERN	0 days	Nov 30 '00	Nov 30 '00
HCAL	ML2	HF-028	HF: Define Fiber Diameter	0 days	Jan 31 '01	Jan 31 '01
HCAL	ML2	HB-039	Complete Front-end Electronics Production	337 days	Jun 30 '01	Oct 31 '02
HCAL	ML2	HB-014	HB+1 Absorber Delivered to CERN	0 days	Dec 31 '01	Dec 31 '01
HCAL	ML2	HO-003	HO Optics Installation on YB Completed	0 days	Jun 30 '03	Jun 30 '03
HCAL	ML2	HB-021	HB: End Installation in Solenoid in UX5	75 days	Dec 01 '03	Mar 31 '04
HCAL	ML2	HO-007	HO End Installation and Tests in UX5	0 days	Apr 30 '05	Apr 30 '05
			Trigger System (WBS 1.3)	**0 days**	**NA**	**Nov 03 '98**
TRIG	ML2	D-081	Complete Initial Muon, Calorimeter, & Global Trigger Desig	-19 days	Nov 30 '98	Nov 03 '98
DAQ	ML2	D-085	Readout Unit Prototype 2 (Design of)	0 days	May 10 '99	May 10 '99
DAQ	ML2	D-086	Event Builder Prototype 1 Complete	-19 days	May 31 '99	May 04 '99
TRIG	ML2	D-082	Complete Phase 1 Prototype Design	-20 days	Nov 30 '99	Nov 02 '99
DAQ	ML2	D-087	Readout Unit Prototype 2 Complete	-20 days	Nov 30 '99	Nov 02 '99
DAQ	ML2	D-088	Filter Unit Prototype 1 Complete	-20 days	Nov 30 '99	Nov 02 '99
DAQ	ML2	D-089	Vertical DAQ Chain Prototype Complete	-20 days	Nov 30 '99	Nov 02 '99
DAQ	ML2	D-010	High Level Trigger Prototype 1 Complete	-20 days	Nov 30 '99	Nov 02 '99
DAQ	ML2	D-011	Full DAQ Prototype Tests Complete	44 days	May 01 '00	Jun 30 '00
DAQ	ML2	D-013	Technologies Choice Presentation: scal 1 N DAQ	21 days	Nov 01 '00	Nov 30 '00
			ECAL system (WBS 1.4)	**0 days**	**NA**	**Jun 01 '98**
ECAL	ML2	E-081	Choice of Avalanche Photodiodes	-21 days	Jun 30 '98	Jun 01 '98
ECAL	ML2	E-084	50% Electronics Channels Test	182 days	Dec 31 '99	Oct 01 '00
ECAL	ML2	E-086	Module 0 (400 channels) Prototype Complete	250 days	Dec 31 '99	Jan 01 '01
ECAL	ML2	E-088	Supermodule 1 Completed	251 days	Jun 30 '00	Jun 30 '01
ECAL	ML2	E-011	Supermodule 1 Calibration and Testing Complete	140 days	Aug 31 '01	Mar 31 '02
ECAL	ML2	E-013	Half-Barrel (18 Supermodules) Calibrated	0 days	Sep 30 '02	Sep 30 '02
ECAL	ML2	E-017	Full-Barrel (36 Supermodules) Completed	0 days	Jun 30 '04	Jun 30 '04
			FPIX System (WBS 1.5)	**0 days**	**NA**	**Dec 01 '98**
FPIX	ML2	T-777	Remaining Milestones up to 2005	316 days	Jul 01 '99	Sep 30 '00
FPIX	ML2	T-081	Final Full Size Sensor - Submission	0 days	Jan 31 '01	Jan 31 '01
FPIX	ML2	T-082	Final Full Size Readout Chip - Submission	0 days	Feb 28 '01	Feb 28 '01



8.3 U.S. LHC Accelerator Construction Project Milestones

Table 8.3. Level 2 U.S. LHC Accelerator Baseline Milestones through FY2001

WBS Identifiers	Milestone Description	Baseline Date	Forecast(F) or Actual(A)
Int Region	Begin 1st inner triplet quadrupole model magnet	1 Jul 97	1 Jul 97 (A)
RF Region	Begin assembly of 1st dipole model magnet	1 Sep 99	10 Jun 99 (A)
SC Cable	Complete SC testing facility upgrades	1 Jun 99	30 Sep 99 (A)
SC Cable	All cable production support equipment delivered to CERN	1 Sep 99	28 May 99 (A)
Int Region	Complete inner triplet quadrupole model magnet program phase 1	1 Dec 99	28 Sep 99 (A)
Int Region	Place purchase order for HTS power leads	1 Feb 00	**1 Sep 00 (F)**
Int Region	Complete inner triplet quadrupole model magnet program phase 2	1 Mar 00	17 Mar 00 (A)
RF Region	Complete dipole model magnet program	1 Aug 00	**15 Sep 00 (F)**
RF Region	Begin RF region beam separation dipole production assembly	1 Sep 00	**8 Oct 01 (F)**
Int Region	Begin absorber fabrication	1 Nov 00	1 Nov 00 (F)
Int Region	Complete inner triplet quadrupole prototype magnet program	1 Oct 01	1 Oct 01 (F)
Int Region	Begin interaction region beam separation dipole production assembly	1 Mar 01	**25 Jul 00 (F)**
Int Region	Begin inner triplet feedbox fabrication	1 Mar 01	1 Mar 01 (F)



ID	Milestone	Original	Revised	Forecast	Actual	Variance
	Project Start (10/1/95)	10/1/95	10/1/95	10/1/95	10/1/95	0 days
IR	Begin 1st Inner Triplet Quadrupole Model Magnet	7/1/97	7/1/97	7/1/97	7/1/97	0 days
SC	Complete Superconductor Test Facility Upgrades	6/1/99	6/1/99	9/30/99	9/30/99	87 days
SC	All Cable Production Support Equipment Delivered to CERN	9/1/99	9/1/99	5/28/99	5/28/99	-88 days
RF	Begin Assembly of 1st Dipole Model Magnet	9/1/99	9/1/99	6/10/99	6/10/99	-59 days
IR	Complete Inner Triplet Quadrupole Model Magnet Program Phase 1	12/1/99	12/1/99	9/28/99	9/28/99	-46 days
IR	Place Purchase Order for HTS Power Leads	2/1/00	2/1/00	9/1/00	NA	153 days
IR	Complete Inner Triplet Quadrupole Model Magnet Program Phase 2	3/1/00	3/1/00	3/17/00	3/17/00	12 days
RF	Complete Dipole Model Magnet Program	8/1/00	8/1/00	9/15/00	NA	33 days
RF	Begin RF Region Dipole Production Assembly	9/1/00	9/1/00	10/8/01	NA	286 days
IR	Begin Absorber Fabrication	11/1/00	11/1/00	11/1/00	NA	0 days
IR	Complete Inner Triplet Quadrupole Prototype Magnet Program	12/1/00	10/1/01	10/1/01	NA	0 days
IR	Begin Interaction Region Beam Separation Dipole Prod. Assembly	3/1/01	3/1/01	7/25/00	7/25/00	-157 days
IR	Begin Inner Triplet Feedbox Fabrication	3/1/01	3/1/01	3/1/01	NA	0 days
IR	Begin Inner Triplet Quadrupole Production Assembly	4/15/01	11/1/01	11/1/01	NA	0 days
RF	Decision on RF Region Quadrupoles	7/1/01	7/1/01	7/1/01	NA	0 days
IR	Complete 1st Inner Triplet Quadrupole Magnet	11/1/01	9/1/02	9/1/02	NA	0 days
RF	Delivery of D3, D4 for IR4 right	1/1/02	1/1/02	1/1/02	NA	0 days
IR	Delivery of D2 for IR8 Left	4/1/02	4/1/02	4/1/02	NA	0 days
IR	Complete Inner Triplet Feedbox Fabrication	5/1/02	5/1/02	5/1/02	NA	0 days
IR	Delivery of All Inner Triplet System Components for IR8 Left (MQX, DFBX, D1)	10/1/02	10/1/02	10/1/02	NA	0 days
RF	Complete RF Region Dipole Production Assembly	10/1/02	10/1/02	10/1/02	NA	0 days
IR	Delivery of D2 for IR5 Left	11/1/02	11/1/02	11/1/02	NA	0 days
RF	Delivery of D3, D4 for IR4 left	11/1/02	11/1/02	11/1/02	NA	0 days
IR	Complete Absorber Fabrication	12/1/02	12/1/02	12/1/02	NA	0 days
IR	Delivery of All Inner Triplet System Components for IR8 Right (MQX, DFBX, D1)	1/1/03	1/1/03	1/1/03	NA	0 days
IR	Delivery of D2 for IR8 Right	2/1/03	2/1/03	2/1/03	NA	0 days
IR	Complete Interaction Region Dipole Production Assembly	3/1/03	3/1/03	3/1/03	NA	0 days
	Project Completion (9/30/05)	9/30/05	9/30/05	9/30/05	NA	0 days

9. TECHNICAL BASELINE STATUS

U.S. ATLAS Construction Project - No change. The U.S. ATLAS collaboration defined a list of initial deliverables representing the U.S. contribution to ATLAS. This list was approved by the JOG in March 1998. Deliverables are listed in the U.S. ATLAS Construction Project Management Plan, Appendix 3.

U.S. CMS Construction Project - No change. The U.S. CMS collaboration defined a list of deliverables representing the U.S. contribution to CMS. This list was approved by the JOG in October 1998. The scope of U.S. CMS contribution is described in the U.S. CMS Management Plan, Appendix 2.

U.S. LHC Accelerator Construction Project - No change. U.S. LHC Accelerator Project - The U.S. deliverables to CERN are defined in the Implementing Arrangement to the Accelerator Protocol. The Implementing Arrangement was signed by the CERN and U.S. signatories in July 1998. Reference the U.S. LHC Accelerator Project Management Plan, Annex II, (Approved 6/15/98).

CERN Direct Purchases - No change. CERN will procure from U.S. industrial firms supplies required to construct the LHC accelerator. These supplies will include superconducting alloy, cable, insulation, and other materials.

10. BASELINE CHANGE ACTIVITY

Baseline Control Level	Baseline Changes
Level 1, DOE/NSF Joint Oversight Group	No changes this quarter
Level 2, DOE/NSF Project Office	
U.S. ATLAS	Changes to the Level 2 cost and schedule baseline.
U.S. CMS	Changes to the Level 2 cost baseline and schedule baselines.
U.S. LHC Accelerator	Changes to the Level 2 cost baseline.

Project Manager's Quarterly Progress Report - 3rd Quarter FY 2000
U.S. Large Hadron Collider Construction Project

APPENDIX A - FUNDING BY INSTITUTION (in thousands of dollars)

U.S. CMS Construction Project

	FY 1998				FY 1999				FY 2000				
	DOE				DOE				DOE				Grand
Institution	Grant	Contract	NSF	Total	Grant	Contract	NSF	Total	Grant	Contract	NSF	Total	Total
FNAL	0	5,517	0	5,517	0	10,817	40	10,857	0	5,981	0	5,981	22,355
Fairfield	0	29	0	29	0	0	0	0	0	10	0	10	39
Maryland	90	65	0	155	0	132	131	263	0	250	0	250	668
Boston U.	0	32	0	32	31	111	0	142	0	132	0	132	306
Florida State	60	54	0	114	71	118	0	189	80	54	0	134	437
U. of Minnesota	60	95	0	155	161	452	0	613	141	202	0	343	1,111
U. of Iowa	77	62	0	139	20	5	0	25	0	453	0	453	617
U. of Rochester	127	1,159	0	1,286	262	485	0	747	441	253	0	694	2,727
Notre Dame	0	52	0	52	0	44	184	228	0	14	193	207	487
Purdue	38	135	0	173	49	166	0	215	0	175	0	175	563
U. of Miss.	46	100	0	146	68	91	0	159	69	108	0	236	541
U. of Florida	44	95	0	139	184	412	0	596	333	853	0	1,186	1,921
Ohio State U.	140	64	0	204	275	212	0	487	196	732	0	928	1,619
Carnegie Mellon	0	113	0	113	0	291	0	291	0	312	0	312	716
Rice	138	19	0	157	102	56	0	158	132	16	0	148	463
U. of Wisconsin	533	1,052	0	1,585	471	3,598	0	4,069	459	3,197	0	3,656	9,310
U.C. Davis	34	100	0	134	0	78	0	78	263	502	0	765	977
UCLA	150	87	0	237	249	173	0	422	244	391	0	635	1,294
U.C. Riverside	20	10	0	30	0	164	0	164	0	70	0	70	264
John Hopkins	0	29	0	29	0	0	70	70	0	0	40	40	139
Northwestern	0	59	0	59	5	26	0	31	0	114	0	114	204
Rutgers	0	13	0	13	0	0	34	34	0	2	140	142	189
Princeton	0	256	0	256	0	626	0	626	0	667	0	667	1,549
Caltech	0	148	0	148	0	458	0	458	0	367	0	367	973
U.C. San Diego	11	0	0	11	11	90	24	125	36	0	0	36	172
Northeastern	0	0	0	0	0	0	3,370	3,370	0	0	1,741	1,741	5,111
U. Ill.-Chicago	0	0	0	0	0	0	124	124	0	0	309	309	433
U. of Nebraska	0	0	0	0	0	0	24	24	0	0	2	2	26
MIT	0	37	0	37	15	67	0	82	0	78	0	78	197
Iowa State	0	0	0	0	0	0	19	19	0	356	0	356	375
Subtotal	1,568	9,382	0	10,950	1,974	18,672	4,020	24,666	2,394	15,289	2,425	20,167	55,783
Reserve	0	0	0	0	0	3,401	1,524	4,925	0	0	0	0	0
Total	1,568	9,382	0	10,950	1,974	22,073	5,544	29,591	2,394	15,289	2,425	20,167	55,783

U.S. ATLAS Construction Project

	FY 1998				FY 1999				FY 2000				
	DOE				DOE				DOE				Grand
Institution	Grant	Contract	NSF	Total	Grant	Contract	NSF	Total	Grant	Contract	NSF	Total	Total
ANL	0	1,098	0	1,098	0	967	0	967	0	922	0	922	2,987
BNL	0	3,903	0	3,903	0	2,581	0	2,581	0	6,429	0	6,429	12,913
LBNL	0	633	0	633	0	715	0	715	0	420	0	420	1,768
SUNY/Albany	20	0	0	20	48	0	0	48	50	0	0	50	118
U. of Arizona	320	100	0	420	634	0	0	634	557	0	0	557	1,611
Boston U.	224	0	0	224	298	0	0	298	287	0	0	287	809
Brandeis U.	265	45	0	310	0	0	593	593	0	0	478	478	1,381
U.C.Irvine	193	0	0	193	0	0	93	93	0	0	0	0	286
U.C. SantaCruz	404	0	0	404	63	0	0	63	0	0	568	568	1,035
U. of Chicago	0	54	0	54	0	0	1,069	1,069	0	0	264	264	1,387
Duke U.	190	0	0	190	601	0	0	601	417	0	0	417	1,208
Hampton U.	0	0	0	0	0	0	538	538	0	0	293	293	831
Harvard	234	0	0	234	0	0	654	654	0	0	390	390	1,278
U. of Illinois	50	159	0	209	347	0	0	347	294	0	0	294	850
Indiana U.	190	0	0	190	765	0	0	765	460	0	0	460	1,415
MIT	50	0	0	50	105	0	0	105	177	0	0	177	332
Michigan State	0	35	0	35	0	0	178	178	0	0	293	293	506
Nevis/Columbia	0	675	0	675	0	0	2,680	2,680	0	0	1,422	1,422	4,777
U. of New Mex.	20	0	0	20	30	0	0	30	24	0	0	24	74
Northern Illinois	0	0	0	0	0	0	0	0	0	0	0	0	0
Ohio State U.	0	0	0	0	100	0	0	100	45	0	0	45	145
U. of Michigan	62	254	0	316	716	0	0	716	518	0	0	518	1,550
U. of Oklahoma	30	0	0	30	0	0	41	41	0	0	51	51	122
U. of Penn.	250	0	0	250	300	0	0	300	265	0	0	265	815
U. of Pittsburg	110	0	0	110	0	0	150	150	0	0	210	210	470
U. of Rochester	0	0	0	0	0	0	3,587	3,587	0	0	1,664	1,664	5,251
U.T. Arlington	50	82	0	132	0	0	474	474	0	0	230	230	836
S. Methodist	40	0	0	40	124	0	0	124	30	0	0	30	194
SUNY/Stony B.	27	0	0	27	0	0	1,045	1,045	0	0	1,037	1,037	2,109
Tufts University	50	0	0	50	20	0	0	20	20	0	0	20	90
U. Washington	0	0	0	0	0	0	240	240	0	0	318	318	558
U. of Wisconsin	230	0	0	230	429	0	0	429	665	0	0	665	1,324
Subtotal	3,009	7,038	0	10,047	4,580	4,263	11,342	20,185	3,809	7,771	7,218	18,798	49,030
Reserve	0	3	0	3	157	0	5,289	5,446	327	1,936	1,795	4,058	4,058
									0	2,602	2,928	5,530	
Total	3,009	7,041	0	10,050	4,737	4,263	16,631	25,631	4,136	12,309	11,941	28,386	53,088